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10/076,022	02/14/2002	John Thomson	073169/0293210	7938

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EXAMINER	
TRAN, KHANH C	
ART UNIT	**PAPER NUMBER**
2631	

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Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)
	10/076,022	THOMSON ET AL.
	Examiner	Art Unit
	Khanh Tran	2631

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *14 February 2002*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-63* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☒ Claim(s) *39-51* is/are allowed.

6)☒ Claim(s) *1-5,11,13-17,23,25-30,36-38,52,53 and 59-63* is/are rejected.

7)☒ Claim(s) *6-10,12,18-22,24,31-35 and 54-58* is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date *02/28/2003*.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Claim Objections

1. Claim 13 is objected to because of the following informalities: in line 2, "training training" should be changed to -- training --; in line 6, "training training" should be changed to -- training --. Appropriate correction is required.

2. Claim 25 is objected to because of the following informalities: in line 2, "training training" should be changed to -- training --. Appropriate correction is required.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

3. Claims 1-5, 11, 13-17, 23, 25-30, 36-38, 52-53, 59-63 are rejected under 35 U.S.C. 103(a) as being unpatentable over Moose U.S. Patent Publication Application 2002/0065047 in view of Crawford U.S. Patent 6,633,616 B2.

Regarding claim 1, Moose application is directed to a method and system for properly tracking, synchronizing and demodulating received packets at a receiver in order to decode data and other informational symbols transmitted by a transmitter. Moose teachings are based on specific specifications, characteristics

and techniques based on the 802.11 standard; see paragraph [0023]. In paragraph [0025], a training sequence (or preamble), illustrated in figure 2, is specified by the standard for synchronization and channel compensation. The sequence is shown consisting of short sync symbols and long sync symbols.

In paragraphs [0026] [0027], a digital synchronization circuitry of a preferred embodiment derives synchronization information from the preamble using an iterative process. During a first iteration a digital cross-correlator 401, as shown in figure 4A, detects an incoming packet on input 407. The correlator is designed to utilize the maximum available coherent energy in the preamble for detection and to generate a sharp peak for an initial symbol-timing estimate. A second iteration is performed using the sample values from the long sync symbols with the timing of the first sample value determined by the initial timing estimate; see paragraph [0034]. According Moose teaching, the long symbol may consist of 52 BPSK modulated sub-carriers. In paragraph [0035], each of these sets of 53 sub-carrier modulation values (52 BPSK modulated carriers plus the DC null value sub-carrier) is divided by the known BPSK sub-carrier modulation values of the long sync symbol creating an estimate of the channel transfer function for each offset to be tested. In light of the foregoing discussion, estimate of the channel transfer function is based on the long sync symbol.

Moose does not expressly teach providing a reference channel estimate as set forth in the application claim. Crawford invention is directed to a pilot phase tracking loop for an OFDM receiver including a phase rotator receiving an

incoming signal. In column 7, lines 5-27, see also figure 2, Crawford discusses the IEEE 802.11a in which whether the data symbol 210 or one of the long symbols T_1 and T_2 includes 48 data bearing subcarriers and a plurality of pilot subcarriers buried within the signal that do not transport data, e.g. 4 pilots in the IEEE 802.11a standard. In column 8, lines 30-60, Crawford further teaches the pilot tracking loop 300 (see figure 3) tracks the phase changes of all of the plurality of pilots for each symbol in order to correct or minimize the phase error for subsequent data symbols relative to the reference points measured during the preamble. In one embodiment, Crawford teaches that the pilots of the long symbols T_1 and T_2 of the OFDM preamble waveform are used to determine the reference points.

Moose and Crawford teach in the same field of endeavor according to IEEE 802.11 standard. Because Moose and Crawford estimate the channel function based on the long symbol portion of the preamble, therefore, it would have been obvious for one of ordinary skill in the art at the time of the invention that Moose teachings can be modified to use the pilots of the long symbol as a reference point for channel estimate. The motivation is obvious because Moose teachings in figure 8 discloses the channel estimate being updated for each update phase change.

In paragraph [0041], pilot tones are inserted in each OFDM data symbol at sub-carrier numbers +-7 and +-21. The four sub-carriers are modulated with BPSK modulation values from a known PN sequence so that phase changes

from data symbol to data symbol occur in a prescribed manner known at the receiver. Moose teachings further disclose that phase changes from these known values are derived from the demodulation sequences extracted from the FFT outputs at the receiver. In view of the foregoing discussion, the demodulation process generates frequency domain representation of the OFDM data symbol including the four pilot symbols.

In paragraph [0043], flow chart in figure 8 represents a tracking sequence based on pilot tones. The pilot-tone tracking loop represents an estimation of phase change based on known transmitted pilot tone phases. At step 811, a least squares fit is made to a straight line of phase change versus sub-carrier frequency using the demodulated phase change values of the four pilot subcarriers. A phase slope of the straight line is updated at step 809. At step 807, estimate of channel response is updated using the updated phase slope at step 809. In light of the aforementioned discussion, the phase slope corresponds to the claimed correction factors. As recited above, Crawford discusses the IEEE 802.11a standard, in which whether the data symbol 210 or one of the long symbols T_1 and T_2 includes 48 data bearing subcarriers and a plurality of pilot subcarriers buried within the signal that do not transport data, e.g. 4 pilots in the IEEE 802.11a standard. The phase change values of the four pilot subcarriers are relative to the phase changes of the pilots of the long sync symbol.

Regarding claim 2, in paragraph [0103] of Moose application, a total phase shift is defined by equation (48) where k is representative of a pilot tone of frequency; see paragraph [0089]. Hence, each k value would produce a phase shift, corresponding to the claimed associated total amount of rotation relative to a corresponding pilot in the at least one first symbol.

Regarding claim 3, referring to the flow chart of figure 8 of Moose application, at step 811, a least squares fit is based on the phase shift for each pilot tone in the OFDM symbol.

Referring to figure 4, referring to the flow chart of figure 8 of Moose application, an update phase slope is generated at step 809. The update phase slopes correspond to the claimed correction factors.

Regarding claim 5, referring to the flow chart of figure 8 of Moose application, Moose employs a least squares fit to straight line from which the slope and phase intercept (γ_m and μ_m) are derived at step 811. At step 809, update phase slope is calculated based on the least squares fit to straight line, which is representative of the ratio of extract pilot tone phase offsets of subcarrier frequency and updated channel response, and the slope and phase intercept (γ_m and μ_m).

Regarding claim 11, in paragraph [0058] of Moose invention, a threshold is set at the correlator output of figure 5. Exceeding the threshold provides detection of an incoming packet.

As recited in claim 2, a total phase shift is defined by equation (48) where k is representative of a pilot tone of frequency; see paragraph [0089]. Hence, each k value would produce a phase shift, corresponding to the claimed associated total amount of rotation for one pilot relative to a corresponding pilot in the at least one first symbol.

From equation (48), because θ_{km} represents the total phase shift of all pilots in the second symbol, the phase shift for each pilot in the second symbol is determined based on the total phase shift in the second symbol.

At step 811, a least squares fit to straight line is determined based on the phase change of each pilot tone (k) and the associated total phase shift for other pilots in the second symbol.

And at step 809, an update phase slope is generated based on the least squares fit, the update phase slope corresponding to the claimed second correction factors.

Regarding claim 13, claim 13 is rejected on the same ground as for claim 1 because of similar scope. Furthermore, in paragraph [0025], a training sequence, or preamble, illustrated in figure 2, is specified by the standard for synchronization and

channel compensation. The preamble includes long sync symbol, which is used for estimating the channel transfer function.

Regarding claim 14, claim 14 is rejected on the same ground as for claim 2 because of similar scope.

Regarding claim 15, claim 15 is rejected on the same ground as for claim 3 because of similar scope.

Regarding claim 16, claim 16 is rejected on the same ground as for claim 4 because of similar scope.

Regarding claim 17, claim 17 is rejected on the same ground as for claim 5 because of similar scope.

Regarding claim 23, claim 23 is rejected on the same ground as for claim 11 because of similar scope.

Regarding claim 25, claim 25 is rejected on the same ground as for claim 1 because of similar scope. Furthermore, in paragraph [0025], a training sequence is illustrated in figure 2 wherein the long sync symbol is used for an estimate of the channel transfer function. The long sync symbol corresponds to the claimed training

symbol. The long sync symbol is sampled before the data symbol, which follows after the training sequence. Hence, "the long sync symbol is sampled before the data symbol" corresponds to the claimed "one training symbol is sample early". The initial channel estimate (in paragraph [0108]) corresponds to the claimed reference channel estimate based upon the first correction factors. The initial timing estimate in paragraphs [0026] [0027] is used to perform a second iteration in paragraphs [0034] [0035] for an estimate of channel function. According to the flowchart in figure 8, an update phase slope is calculated at step 809 after the initial timing estimate applies at step 801. As recited in claim 1, initial update phase slope corresponds to the claimed first correction factors. Moose does not expressly teach the step of determining a number of clock cycles as set forth in the application claim. Nevertheless, the total phase shift based on initial timing estimate would correspond to the number clock cycles that the training symbol is sampled early. The initial frequency offset correction is applied at step 801, that act corresponding to the claimed adjust the frequency domain representation based upon the first correction factors.

Regarding claim 26, the training sequence is known and user input, therefore, selecting a training symbol having a substantially flat phase response would have been obvious for one of ordinary skill in the art.

Regarding claim 27, claim 27 is rejected on the same ground as for claim 14 because of similar scope.

Regarding claim 28, claim 28 is rejected on the same ground as for claim 15 because of similar scope.

Regarding claim 29, claim 29 is rejected on the same ground as for claim 16 because of similar scope.

Regarding claim 30, claim 30 is rejected on the same ground as for claim 17 because of similar scope.

Regarding claim 36, claim 36 is rejected on the same ground as for claim 23 because of similar scope.

Regarding claim 37, claim 37 is rejected on the same ground as for claim 25 in view of claims 26-29 because of similar scope.

Regarding claim 38, claim 38 is rejected on the same ground as for claim 25 in view of claims 26-30 because of similar scope.

Regarding claim 52, claim 52 is rejected on the same ground as for claim 13 in view of claims 14-15 because of similar scope. Moose does not show a memory for storing the reference channel estimate. Nevertheless, Crawford discloses reference point storage 308 in figure 3. Moose does not show a second multiplier as set forth in

the application claim. Nevertheless, referring to figure 8 of Moose invention, at step 807, a channel response is updated based on an update phase slope in step 809. Hence, the step of updating channel response would perform a multiplication as shown in the equation at step 807.

Regarding claim 53, claim 53 is rejected on the same ground as for claim 5 because of similar scope.

Regarding claim 59, claim 59 is rejected on the same ground as for claim 11 because of similar scope.

Regarding claim 60, claim 60 is rejected on the same ground as for claim 1 because of similar scope. Furthermore, Moose does not teach the step of calculating a reference power based upon pilots of the at least one training symbol. Nevertheless, Crawford teaches a quality estimator 408 (figure 4) calculates a measure of the pilot tracking loop's quality. The measure is the total power present in the 4 pilot subcarriers of each symbol; see column 15, lines 28-43. Because power calculation is known in the art and can be used as an alternative for estimating and updating channel estimate, one of ordinary skill in the art at the time of the invention was made that Moose invention can be modified to use power calculation instead.

Regarding claim 61, Crawford further shows a loop filter 314 in figure 3 located after pilot phase error metric 310, which includes quality estimator 408. Hence, the symbol power is further filtered by the loop filter. Therefore, the scaling calculation would be based on the filtered symbol power.

Regarding claim 62, claim 62 is rejected on the same ground as for claim 52 in view of claim 60 because of similar scope.

Regarding claim 63, claim 63 is rejected on the same ground as for claim 61 because of similar scope.

Allowable Subject Matter

4. Claims 6-10, 12, 18-22, 24, 31-35, 54-58 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

5. Claims 39-51 are allowed.

The following is a statement of reasons for the indication of allowable subject matter:

Regarding claims 39 and 51, claim are allowable over the prior art of record because the cited references do not teach or suggest an apparatus for maintaining an

accurate channel estimate comprising "*an angle-to-converter that is to produce a plurality of first correction factors based upon the number of clock cycles*" and "*a first multiplier that is to adjust the frequency domain representation based upon the first correction factors to produce a reference channel estimate*".

Conclusion

6. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

Crawford U.S. Patent 6,549,561 B2 discloses "OFDM Pilot Tone Tracking For Wireless LAN".

Crawford U.S. Patent 6,549,583 B2 discloses "Optimum Phase Error Metric For OFDM Pilot Tone Tracking For Wireless LAN".

7. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Khanh Tran whose telephone number is 571-272-3007. The examiner can normally be reached on Monday - Friday from 08:00 AM - 05:00 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Mohammad Ghayour can be reached on 571-272-3021. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

KCT

Khanhcong Tran 05/27/2005

Examiner KHANH TRAN